

NON-PUBLIC?: N
ACCESSION #: 9112230239
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Waterford Steam Electric Station Unit 3 PAGE: 1 OF 12

DOCKET NUMBER: 05000382

TITLE: Inadvertent Engineered Safety Feature Actuations due to Plant
Protection System Test Circuit Malfunction
EVENT DATE: 11/17/91 LER #: 91-022-00 REPORT DATE: 12/17/91

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR
SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: W. R. Brian, Plant Engineering TELEPHONE: (504) 464-3127
Superintendent

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: JC COMPONENT: IMOD MANUFACTURER: C49B
REPORTABLE NPRDS: N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At 0324 hours on November 17, 1991, while performing OP-903-107, Plant Protection System Functional Test, the plant received a Safety Injection Actuation Signal (SIAS), Containment Isolation Actuation Signal (CIAS), and Main Steam Isolation Signal (MSIS). Subsequently, a reactor trip occurred on loss of power to the Control Element Drive Mechanism motor generator sets due to the SIAS. Operations Control Room personnel entered the Emergency Operating Procedures and carried out the immediate operator actions. Recovery was performed in accordance with OP-902-006, Loss of Main Feedwater Procedure. Inspection of the test cabinet revealed a loose wire connection in the CD matrix test circuitry. The loose wire connection was tightened and a system retest was performed satisfactorily.

The cause of this event was a test circuit malfunction which was caused

by a loose connection on TB701 Terminal 2. The cause of the loose connection could not be positively determined and may have existed for some time. Waterford 3 is implementing a design change to install test circuit enhancements.

END OF ABSTRACT

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Reportable Occurrence:

At 0324 hours on November 17, 1991, while performing OP-903-107, Plant Protection System Functional Test, on the channel CD matrix module (EIIS Identifier - JC/IMOD) actuations of the Safety Injection Actuation Signal (SIAS), Containment Isolation Actuation Signal (CIAS), and Main Steam Isolation Signal (MSIS) occurred. A reactor trip occurred when the SIAS opened the power supply breakers (EIIS Identifier - EC/BKR) for the Control Element Drive Mechanism (CEDM) Motor Generator Sets (EIIS Identifier - AA/MG). Four hour notification via the Emergency Notification System (ENS) was made to the NRC at 0619 hours in accordance with 10CFR50.72(b)(2)(ii) due to unplanned Engineered Safety Features (ESF) (EIIS Identifier - JE) and Reactor Protection System (RPS) (EIIS Identifier - JC) actuations. This event is reportable under 10CFR50.73(a)(2)(iv) as an unplanned ESF (including RPS) actuation.

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Initial Conditions:

Plant Power: 100%

Mode: 1

Procedure being performed:

OP-903-107, Plant Protection System Functional Test, Section 7.24, Matrix Test, Module CD.

Technical Specification LCOs in Effect:

3.3.1 - Plant Protection System (PPS) Channel "C" High Linear Power
3.6.4.1 - Containment Hydrogen Analyzer "B"
3.9.7 - Spent Fuel Handling Machine

Major Equipment Out of Service:

MS-320B, Steam Bypass to Condenser B2 (EIIS Identifier - SB/V) due to a weld crack on the steam bypass line at the Main Condenser (EIIS identifier - SG) penetration

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Event Sequence:

The Waterford 3 Plant Protection System (PPS), provided by Combustion Engineering, consists of four independent channels providing, when required, automatic reactor shutdown capability with the Reactor Protection System (RPS) (EIIS Identifier - JC) and actuation of the Engineered Safety Feature (ESF) systems (EIIS Identifier - JE). In accordance with Technical Specifications 4.3.1.1 and 4.3.2.1, a functional test of each PPS channel is performed once per month. The Logic Matrix Test portion of the functional test verifies proper operation of the six, two-out-of-four coincidence, logic matrices. During the circuit test sequence, the relay hold pushbutton is depressed and through use of the early closure contacts, test circuit power is applied to the aiding coils of the matrix trip path relays not in test, before the bistable coils are energized on the matrix trip path relays in test.

The operator performing the functional test completed matrix relay testing of the SIAS/CIAS/MSIS for positions 1, 2, and 3 on the matrix relay trip select switch. The Plant Monitoring Computer (EIIS Identifier - IQ) Alarm printout indicated that all relays were reset before the next test was performed. The operator selected the #4 position on the matrix relay trip select switch and pushed the matrix relay hold pushbutton. When the pushbutton was pushed at 0324 hours, an actuation of the SIAS, CIAS, and MSIS occurred.

The Secondary Nuclear Plant Operator (SNPO) noted the annunciator actuations and indications of a Reactor Power Cutback (RPC) with CEA groups 5 and 6 inserted. The RPC actuated due to the rate of rise of Pressurizer (EIIS Identifier - AB/PZR) pressure and decrease in Main Steam (EIIS Identifier - SB) flow resulting from the closure of the Main Steam Isolation Valves (MSIV) (EIIS Identifier - SB/ISV). At 0324 hours, a reactor trip occurred due to the SIAS actuation causing the power supply breakers for CEDM Motor Generator Sets A and B to open.

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During this event the Reactor Coolant System (RCS) (EIIS Identifier AB) pressure did not exceed 2230 psia and the pressurizer safety relief valves (EIIS Identifier - AB/RV) did not lift. Minimum RCS pressure

reached was 1940 psia, which is above the automatic SIAS setpoint of 1684 psia. No safety injection flow was initiated into the RCS. Steam Generator (SG) (EIIS Identifier - AB/SG) #1 and #2 pressure increased to 1120 psia. The Main Steam Safety Valves (MSSV) (EIIS Identifier - SB/RV) lifted and the Atmospheric Dump Valves (ADV) (EIIS Identifier - SB/PCV) on both Steam Generators opened due to the pressure increase. Recovery of the plant was performed in accordance with the Emergency Operating Procedure OP-902-006, Loss of Main Feedwater Recovery Procedure.

While performing plant recovery in OP-902-006, CVC-101, (Letdown to Regenerative Heat Exchanger from Reactor Coolant Loop 1B Isolation Valve) (EIIS Identifier - CB/ISV) (Fisher Controls Co., Model 667DBQ70) was noted as not being closed. SIAS automatically closes this valve. Investigation of this problem commenced on November 17, 1991, at 1439 hours. A sticking solenoid valve (EIIS Identifier - LD/SHV) (ASCO Electrical Products Co., Inc. Model X2068326F) was discovered and replaced. CVC-101 tested satisfactorily after solenoid valve replacement. The valve was declared operable at 2246 hours on November 17, 1991.

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Sequence of Events:

0322 * Commence test of Matrix CD SIAS/CIAS/MSIS
0324 * Completed testing Matrix CD SIAS/CIAS/MSIS Trip Path 1, 2, and 3; all relays reset, no actuations
ESFAS Actuation (SIAS, CIAS, MSIS) when Matrix CD SIAS/CIAS/MSIS Trip Path 4 tested
Reactor Power Cutback (RPC)
Main Steam Safety Valves Open
Reactor Trip Actuated
Emergency Feedwater Actuation Signal (EFAS) #1 and #2 due to low level in Steam Generators 1 and 2
0327 * Entered OP-902-000, Emergency Entry Procedure
0334 * Entered OP-902-006, Loss of Main Feedwater Recovery Procedure
* Exit OP-902-000
0337 # Feeding Steam Generator (SG) #1 with Emergency Feedwater (EFW)
0344 # Feeding SG #2 with EFW
0401 * Reset SIAS and CIAS
0435 * Enter Technical Specification (TS) LCO 3.7.1.3 due to low level in the Condensate Storage Pool (CSP) (EIIS Identifier - BA/TK)
0458 * Reset EFAS-1 and EFAS-2, Reset MSIS

0502 * Opened Main Feedwater Isolation Valves (EIIS Identifier - SJ/ISV) "A" and "B"
0601 * Started Auxiliary Feedwater Pump (EIIS Identifier - SJ/P)
0821 * Opened Main Steam Isolation Valves (MSIV) (EIIS Identifier - SB/V) #1 and #2
0822 * Secured EFW Pump A/B (EIIS Identifier - BA/P)
0840 * Exit OP-902-006 (exit criteria met)
* Entered OP-10-001, "General Plant Operations"
0841 * Secured EFW Pumps A and B
0910 * Exit TS LCO 3.7.1.3

- Automatic Action * - Manual Action

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Investigation of the inadvertent actuation commenced under Condition Identification (CI) 278156 and Work Authorization (WA) 01086625 on November 17, 1991, at 1021 hours. A loose wire connection was found in the test power supply circuit for the CD matrix at terminal board TB702 terminal 2. Slightly loose connections were also found in AC matrix test module TB702 terminal 2 and in AD matrix test module TB702 terminal 1, but the looseness may have been a result of the tightness check. Connections were also checked on matrix test modules AB, BC, and BD, and all connections were found tight.

ABB Combustion Engineering provided an analysis (TIC-91-1666-C) of the actuation at Waterford 3 on November 21, 1991. The analysis concluded "Because of the series connection of the test power within the matrix test modules, a firm and proper termination of these wires is essential for the proper operation of the test circuits ...". The analysis further states "A single failure could be postulated because of this loose termination which would effectively bypass the delay function, which is normally provided by the HOLD pushbutton switch ...".

Waterford 3 reviewed the ABB Combustion Engineering analysis and included the analysis as a supplement to Station Modification Request SMR-PPS-006. Station Modification Request SMR-PPS-006 has been approved as Design Change DC-3371. DC-3371 is being implemented to address problems associated with PPS matrix relay testing and is discussed in more detail in the corrective action section of this report.

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CAUSAL FACTORS:

Test Circuit Malfunction: The cause of this event was a test circuit

malfunction which was caused by a loose connection on TB702 Terminal 2. The cause of the loose connection could not be positively determined and may have existed for some time. One possible activity which may have caused the loose wire was replacement of the CD matrix pushbutton (WA 01065058) performed during Refueling Outage 4. However, no clear evidence exists to draw a firm conclusion. Contributing was the orientation of the terminal blocks which makes detection of a loose connector difficult

CORRECTIVE ACTIONS:

- o Terminal board connections for all six Matrix Test Modules were checked.
- o The connection at TB701 Terminal 2 in Matrix Test Module CD was tightened.
- o Loose connections were tightened on Module AC TB702 Terminal 2 and Module AD TB702 Terminal 1.
- o Although a specific cause for the loose connection could not be determined, orientation of the terminal blocks which are not easily accessible will improve the likelihood of detecting any future loose terminal connections. DC-3371 is being implemented to address problems associated with the circuit configuration which hinders the ability to ensure secure connections. In addition, DC-3371 addresses 1) the "relay race" condition which potentially allows the trip path relays to deenergize before the aiding coils fully energize, and 2) test pushbutton assembly problems discussed in previous LERs (see Previous Events section for specifics). DC-3371 will be completed prior to completion of Refuel 5.

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SAFETY SIGNIFICANCE:

Equipment Problems:

All ESF actuated components functioned as required with the exception of valve CVC-101, (Letdown to Regenerative Heat Exchanger from Reactor Coolant Loop 1B Isolation Valve) (EIIIS Identifier - CB/ISV) (Fisher

Controls Co., Model 667DBQ70). CVC-101 did not close as required by the SIAS actuation. Under Work Authorization 01086625, a sticking solenoid valve (EHS Identifier - LD/SHV) (ASCO Electrical Products Co., Inc. Model X2068326F) was discovered and replaced. CVC-101 tested satisfactorily after solenoid valve replacement.

Waterford 3 Maintenance Engineering is investigating the specific failure mechanism of the solenoid valve, including a failure analysis by an offsite laboratory.

Analysis:

Because of the reactor power cutback, which occurred due to the MSIS signal, the RCS pressure transient was significantly less severe than for a Loss of Condenser Vacuum or a Loss of Main Feedwater event. As a result of the inadvertent SIAS, CEA's had already begun to drop into the core prior to the occurrence of a Reactor Trip signal. The consequences of this event are bounded by the accidents previously analyzed in FSAR sections 15.1.1.4 (Inadvertent ADV opening), 15.2.1.3 (Loss of Condenser Vacuum), and 15.2.2.5 (Loss of Main Feedwater). Inadvertent ADV Opening is a Moderate Frequency incident, and Loss of Condenser Vacuum and Loss of Main Feedwater are classified as Infrequent incidents.

The problem with the loose wire connection was confined to the PPS test circuitry and did not interfere with the protective features of the PPS system. Should there have been an actual need for PPS actuation, the PPS system would have functioned as required.

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The failure of CVC-101 to close did not affect this event and would not have affected an actual situation requiring an SIAS since the backup valve, CVC-103, functioned as required. Therefore, the health and safety of the general public and plant personnel was not jeopardized during this event.

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PREVIOUS EVENTS:

Industry Events:

02/19/88: At San Onofre 3, while performing a plant protection system functional test, an SIAS occurred when the matrix relay hold pushbutton was depressed. Pushbutton was model 10250T506 (Cutler-Hammer).

02/18/89: At San Onofre 2, while performing a PPS functional test, a spurious EFAS actuation occurred. Root Cause determined that the pushbutton internals had been installed incorrectly during the manufacturing process. Pushbutton was model 10250T (Cutler-Hammer).

06/19/91: At Palo Verde, an inadvertent Containment Spray Actuation Signal was generated during PPS matrix relay testing. An improperly assembled Matrix Relay Hold Pushbutton was found.

06/29/89 At San Onofre 3, a Recirculation Actuation Signal occurred when the matrix relay hold pushbutton was depressed and no trip path was selected. Pushbutton was model 10250T506 (Cutler-Hammer).

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Waterford 3 Events:

LER-91-019:

While performing OP-903-107, Plant Protection System Functional Test, on the channel AC matrix module an actuation of the SIAS, CIAS, and MSIS occurred. The root cause of this event was a design problem with the matrix test circuit. An actuation occurred as a result of the "relay race" condition which potentially allows the trip path relays to deenergize before the aiding coils fully energize, causing the bistable relay contacts to interrupt power to the four matrix relay aiding coils before the test circuit voltage was fully applied to the Matrix holding coil.

LER-90-004:

An inadvertent Emergency Feedwater Actuation (EFAS) occurred during Plant Protection System matrix relay testing. The root cause of this event was a test circuit malfunction due to the incorrect assembly of the early closing contact block assembly of the matrix relay hold pushbutton.

LER-85-006:

An inadvertent Containment Spray Actuation (CSAS) occurred during PPS functional testing due to personnel error. The operator did not reset the CSAS actuation relays when required during testing.

ATTACHMENT 1 TO 9112230239 PAGE 1 OF 1

Entergy Entergy Operations, Inc.
Operations P.O. Box B
Killona, LA 70066
Ref: 10CFR50.73(a)(2)(iv) Tel 504-464-3120

D. F. Packer
General Manager
Plant Operations
Waterford 3

W3B5-91-0335
A4.05
QA

December 17, 1991

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Submittal of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report Number LER-91-022-00 for Waterford Steam Electric Station Unit 3. This Licensee Event Report is submitted pursuant to 10CFR50.73 (a)(2)(iv).

Very truly yours,

D. F. Packer
General Manager - Plant Operations

DFP/JDC
Attachment

cc: Messrs. R.D. Martin
G.L. Florreich
J.T. Wheelock - INPO Records Center
E.L. Blake
N.S. Reynolds
NRC Resident Inspectors Office

*** END OF DOCUMENT ***
